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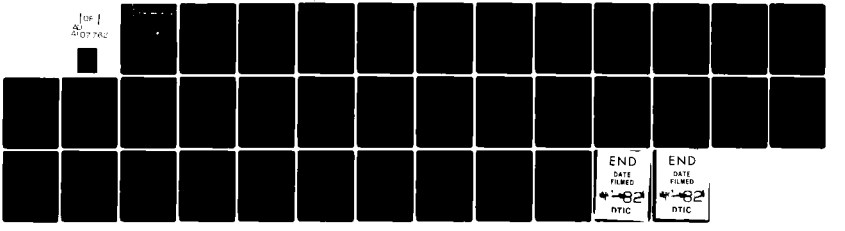

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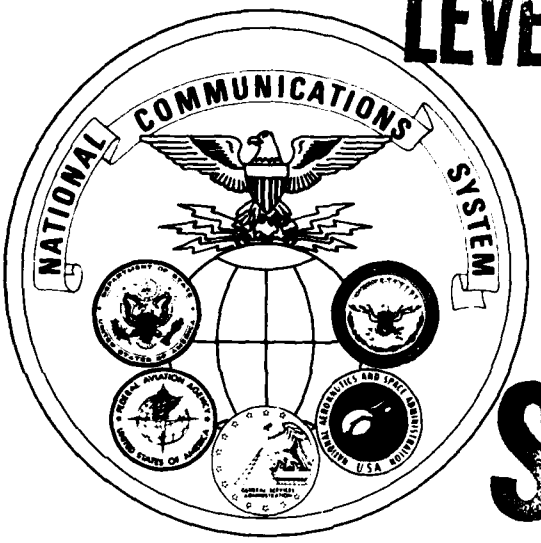

TECHNICAL INFORMATION BULLETIN

81-8

DEVELOPMENT OF A SYSTEM TO VALIDATE GROUP 3 FACSIMILE EQUIPMENT PHASE I

JULY 1981

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Technical Information Bulletin presents the Phase I results of a program to develop a system to validate Group 3 facsimile equipment as specified in Federal Standards 1062 and 1063. The Phase I report develops a validation system methodology that is cost-effective, timely, feasible, and assures an acceptable confidence level of Group3 system interoperability. The Phase II effort, which is currently underway, will implement and test the methodology developed in Phase I.

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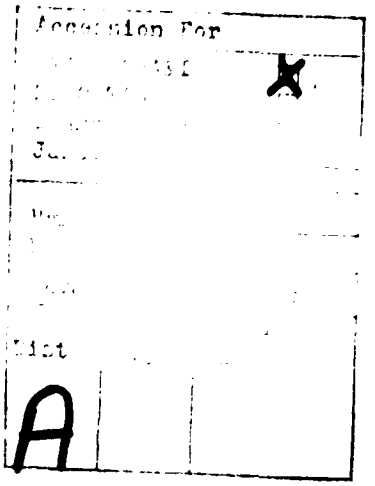

NCS TECHNICAL INFORMATION BULLETIN 81-8

DEVELOPMENT OF A SYSTEM TO VALIDATE GROUP 3 FACSIMILE EQUIPMENT

PHASE I

JULY 1981

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FOREWORD

Among the responsibilities assigned to the Office of the Manager, National Communications System, is the management of the Federal Telecommunication Standards Program which is an element of the overall GSA Federal Standardization Program. Under this program, the NCS, with the assistance of the Federal Telecommunication Standards Committee identifies, develops, and coordinates proposed Federal Standards which either contribute to the interoperability of functionally similar Federal telecommunication systems or to the achievement of a compatible and efficient interface between computer and telecommunication systems. In developing and coordinating these standards a considerable amount of effort is expended in initiating and pursuing joint standards development efforts with appropriate technical committees of the Electronic Industries Association, the American National Standards Institute, the International Organization for Standardization, and the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union. This Technical Information Bulletin presents an overview of an effort which is contributing to the development of compatible Federal, national, and international standards in the area of digital facsimile standards. It has been prepared to inform interested Federal activities of the progress of these efforts. Any comments, inputs or statements of requirements which could assist in the advancement of this work are welcome and should be addressed to:

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DEVELOPMENT OF A SYSTEM TO VALIDATE GROUP 3 FACSIMILE EQUIPMENT

JULY 27, 1981

FINAL REPORT

PHASE I

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TABLE OF CONTENTS

1.0 INTRODUCTION

This document summarizes work performed by Delta Information Systems, Inc. for the office of Technology and Standards of the National Communications System, an organization of the U. S. Government, under contract number DCA100-81-C-0023.

The Office of Technology and Standards, headed by National Communications System Assistant Manager Marshall L. Cain, is responsible for the management of the Federal Telecommunications Standards Program, which develops telecommunication standards whose use is mandatory by all Federal agencies.

The objective of this program is to develop a system to validate Group 3 facsimile equipment as specified in Federal Standards 1062 and 1063. (The Federal standards incorporate Electronic Industry Standards, EIA RS-465 and RS-466 respectively). The program consists of two phases. In Phase I the methodology for the validation of Group 3 facsimile equipment is developed. The objective of Phase I is to develop a validation system methodology that is cost-effective, timely, feasible and assure an acceptable confidence level of Group 3 system interoperability.

In Phase II the validation methodology, developed in Phase I, is implemented and tested. This document comprises the final report on the results of the Phase I effort. The Phase I effort was divided between the three tasks listed below. The work accomplished on each task is summarized in

Sections 2.0, 3.0, and 4.0 respectively.

- Hardware Software Trade off Analysis
- Analysis and Definition of the Validation Tests
- Validation System Implementation

In Section 2.0 three different ways of implementing the system are evaluated - all hardware, all software, and a hybrid hardware/software approach. It is concluded that the hybrid approach is superior. In Section 3.0 the test methodology is developed, and a specific test plan is proposed. Finally in Section 4.0 the hardware and software characteristics of the proposed system are described.

2.0 HARDWARE/SOFTWARE TRADEOFF ANALYSIS

2.1 All Hardware

Hypothetically, it is conceivable that the Group 3 facsimile equipment validation task could be accomplished entirely or predominanty in hardware. There are serious drawbacks to this approach :

1. It is simply not feasible, in terms of cost and timeliness, to design the validation hardware from scratch.
2. It is impractical to cost-effectively utilize available facsimile equipment in an all-hardware approach. This hardware is designed to accomplish the facsimile transmission function and not to verify conformity with standards. A considerable hardware redesign effort would be unavoidable.
3. Much current Group III hardware is implemented with microcomputer-based technology so software or firmware is unavoidable.
4. Control and flexibility of testing is more readily accomplished within a software contextual design framework.

2.2 All Software

It is also conceivable that the Group 3 facsimile equipment validation task could be accomplished by means of software resident on a large high-speed mainframe.

computer with the barest minimum of hardware reconciling the incompatibilities at the interface between the computer and facsimile equipment under test. This approach has the following drawbacks:

1. The software design task is maximized and it is unlikely that this task can be diminished by means of any available facsimile software. This could make the scope of the software task prohibitive in terms of cost and timeliness.
2. The hardware task is not eliminated because implementation of some functions (such as modem, equalizer, line connection etc.) in hardware is unavoidable.
3. Unless computer and test equipment are co-resident, hardware will be needed to interface phone lines at both ends of the circuit.
4. Computer availability presents a problem in that a fully dedicated computer would be too costly, and a time sharing service computer would not satisfy the requirement for real-time processing, access to privately owned computer facilities would be continginent upon the vagaries and higher priority of the owner's needs.

2.3 Hybrid Hardware-Software

The serious drawbacks against both the all-hardware and the all-software implementation concepts favor

an approach to Group 3 facsimile equipment validation based on a balanced mix of hardware and software. The basic system block diagram is depicted in Figure 2-1.

It is shown that the proposed hybrid Validation System has two basic parts. A Facsimile Communication Subsystem (FCS), implemented in hardware and firmware, interfaces with the unit under test via the telephone network simulator. Most of this hardware/firmware has been developed for data transmission in general (v.27 ter/V.29 modems)or specifically for Group 3 facsimile systems. The FCS would be microprocessor controlled and would perform the following functions:

1. Line Control to interface the validation system with the facsimile unit under test.
2. V.27 ter/V.29 modems - to handle facsimile data at the various data rate.
3. Modem control and switching - to switch data paths between low and high speed modems used during identification/set-up signalling and data transmission respectively.
4. Signal generation and formatting - to provide for both tonal and binary signalling.
5. Equalization - to compensate for line distortion.

Along with the Group 3 oriented facsimile hardware and firmware/software of the FCS, Delta Information System, Inc. proposes to incorporate an intelligent terminal as the General Purpose System Control Sub-

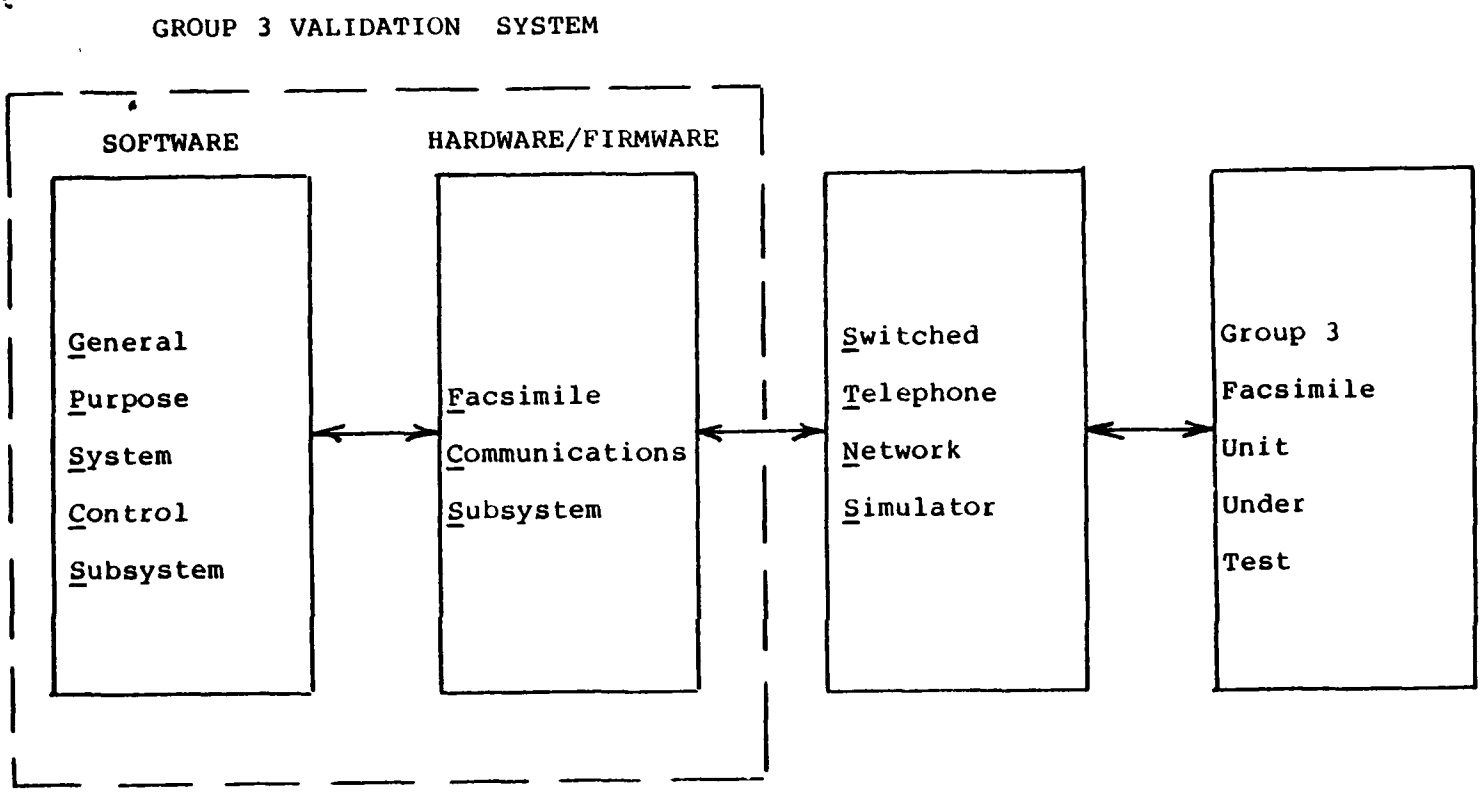


Figure 2-1

BASIC VALIDATION SYSTEM BLOCK DIAGRAM

system (GPSCS). The purpose of the GPSCS is to:

1. Control and organize the Group 3 facsimile system elements.
2. To orchestrate the validation test and monitoring procedures.
3. To provide the library of appropriate test pages, stored in compressed data form, used to exercise the facsimile unit under test.
4. To capture, store and analyze data received from the facsimile under test and to generate validation reports.

The Switched Telephone Network Simulator (STNS) is intended to simulate circuits with a high loss and will be comprised of simple attenuators.

The above described implementation of validation system functions is accomplished by combining existing Group 3 hardware and software/firmware with an intelligent terminal (hardware and software) whose capabilities simultaneously reduces the validation system development effort and makes the stated objectives of Phase I attainable.

A more detailed description of the proposed validation systems and the approach to its implementation in Phase II is discussed in Section 4.

3.0 ANALYSIS AND DEFINITION OF THE VALIDATION TEST

3.1 Methodology

A Validation System with existing Group 3 hardware-firmware/software (as described in Section 2.3) provides a flexible facility which can initiate and receive facsimile calls and also send and receive compressed document, data. This facility in conjunction with the test plan and test documents comprise a viable methodology for validation testing.

Validation testing aims to assure Group 3 facsimile interoperability through standards conformity verification. However, an exhaustive test capability for all equipment combinations under all operational conditions, parametric tolerances, etc., is both unnecessary and unrealistic. Therefore, this unrealistic objective may be replaced by the relaxed objective of assuring that those facsimile equipments that pass the validation tests will be interoperable under an acceptably high percentage of conditions defined in the standards. The hardware tradeoff analysis of Section 2.3 was carried out within this context. Also, it is within the context that the validation test conditions and range of parameters must be narrowed and bracketed so as to arrive at a test plan that is both feasible and acceptable.

3.2 Test Parameters and Conditions

Table 3-1 summarizes Group 3 parameters and procedures

TABLE 3-1
GROUP 3 FACSIMILE EQUIPMENT PARAMTERS & PROCEDURES

		Facsimile Information Field
• Printer/Scanner		
Minimum Scan Line Time		Yes
Vertical Resolution		Yes
Paper Handling:	Max. Width	Yes
	Max. Length	Yes
• Encoder/Decoder		
Coding Scheme:	Mod. Huffman	Yes
	Mod. Read	Yes
Mode:	Pass	
	Horizontal	
	Vertical	
	Uncompressed	
Parameter:	K=2 Standard	
	K=4 Opt.	
Procedure:	EOL	
	Fill	
	RTC	
	Make-up Codes	
• Equalizer		
• Scrambler/Descrambler		
• Modulation/Demodulation		
Procedural Signalling Rate		Yes
Data Direction (send or receive)		Yes
Data Rate		
. Carrier Frequency		
. Signal Generator Distortion		
. Modulation Rate		
. Energy Spectrum		
. Signal Power Level		
. HDLC Frame Structure		

as related to facsimile equipment components, and Table 3-2 summarizes parameters and procedures as related to facsimile document transmission.

Certain of the technical parameters, listed in Table 3-1, such as:

- Carrier frequency
- Signal Generator distortion
- Modulation rate
- Energy spectrum
- Signal power level
- K parameter
- HDLC Frame structure

will be exercised by sending and receiving documents, because the validation system hardware-software/firmware is itself built in conformity with the Standards. Standards conformity for these parameters will be established at the level of successful document transmission.

Eight of the remaining items listed in Table 3-1 will be validated as individual tests are performed, by setting and/or checking set-up control bits of the Facsimile Information Field (FIF) associated with DIS/DTC and DCS Facsimile Control Fields (FCF).

The following Figure and Tables from EIA RS466 are included here to clarify the discussion. The HDLC frame structure for the intial identification (DIS) sequence binary coded command/response is shown in Figure 3-1; the complete list of commands and appropriate

Table 3-2

GROUP 3
DOCUMENT TRANSMISSION PARAMETERS & PROCEDURES

- Control/Set-up/Document Transmission Protocol

  Call Phases
  A. Call Establishment
  B. Pre-message procedure
     Commands:
      Initial Identification } Fax Info Field
      Command to Send } (set up Info)
      Command to Receive }
     Responses:
      Procedure Complete
      Retrain
      Repeat
  C. Message Transmission
  D. Post Message Procdure
     Commands:
      End of page
      Multiple page
      End of procedure
      Operator Intervention
     Responses:
      Confirmation
      Retrain
      Procedure interrupt
      Repeat
  E. Call release
     Disconnect

- Document Handling
  Single
  Multiple
  Direction of Transmission

- Operating Method
  Manual-manual
  Manual-automatic
  Automatic-manual
  Automatic-automatic

- Timing
  Delay for Automatic Repeat: ID
  Command

  Time outs: T1 Identification
  T2 Command Response
  T3 Proceudre Interrupt Operator Intervention

  Tolerance: Modulation Mode Change
  Training Check
  HDLC - Preamble to Frame Duration
  Tonal Signals

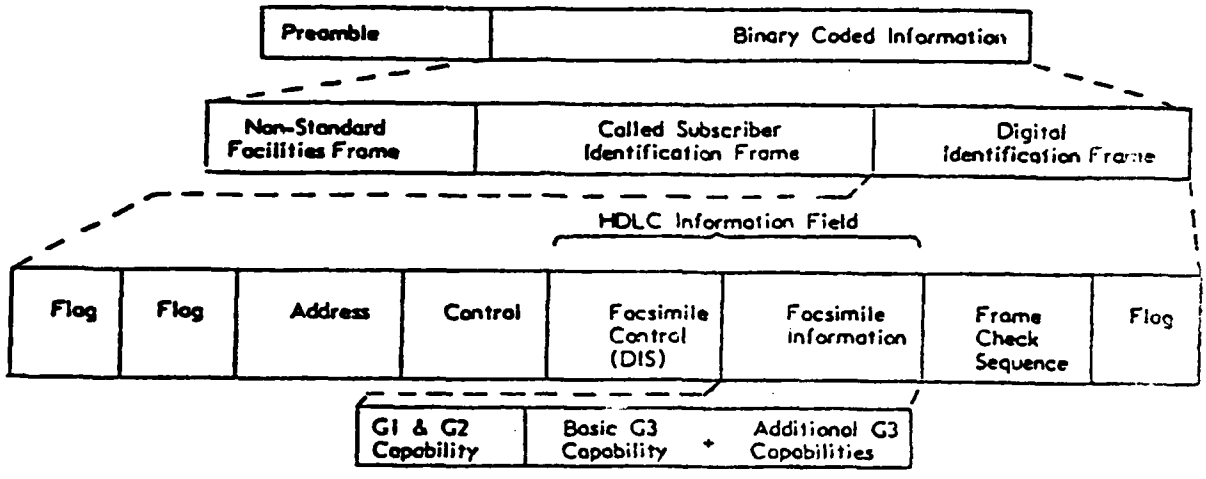


Figure 3-1

HDLC FRAME STRUCTURE FOR INITIAL IDENTIFICATION (DIS) SEQUENCE

responses is shown in Table 3-3; the list of command/ responses their function, signal, format and EIA RS466 reference is given in Table 3-4; the bit assignments for the DIS/DTS and DCS FIF is given in Table 3-5. Most of the other items listed in Table 3-1 will be validated using appropriate test documents to stimulate and exercise the functions.

The Group 3 control/set-up document transmission protocol, listed in Table 3-2 will be validated (for all call phases) for conformity with the list of commands and their appropriate responses given in the Table 3-3. This will be accomplished by a series of tests under the operating methods and document handling conditions listed in Table 3-2. All standard commands and their appropriate responses will be exercised by appropriate test sequences. However, since the command/response logic is not sequential all possible sequences need not be exercised. It is only necessary that each command/ response linkage be exercised at least once during testing. Exercise of command/response sequences which involved or result in operator intervention will be minimal compared to the standard automated sequences. Certain command/response sequences that are non-standard, open to manufacturers interpretation, or otherwise not tied down, will not be exercised during the validation testing.

Table 3-3

LIST OF COMMANDS AND APPROPRIATE RESPONSES

COMMANDS	COMMENTS	APPROPRIATE RESPONSES
(NSF) (CSI) DIS	Identifying capabilities: from a Manual Receiver or an Auto Answer Unit	(NSC) (CIG) DTC (TSI) DCS (CRP) (TSI) (NSS)
(NSC) (CIG) DTC	Mode setting command: from the Calling Unit. This is a poll operation.	(TSI) DCS (NSF) (CSI) DIS (CRP) (TSI) (NSS)
(TSI) DCS (TSI) (NSS)	Mode setting command: from Manual Transmitter or Automatic Transceiver. This command is always followed by phasing/ training.	CFR FTT (NSF) (CSI) DIS (CRP)
MPS or EOP or EOM or (PRI-MPS) or (PRI-EOP) or (PRI-EOM)	Post-message commands	MCF RTP RTN PIP PIN (CRP)
DCN	Phase E command	None

Note: Where the symbols ( ) are used, the signals within these symbols are optional.

Table 3-4

INDEX OF ABBREVIATIONS USED IN EIA STANDARD RS-466

ABBREV-IATION	FUNCTION	SIGNAL FORMAT	REFERENCE
CED	Called Station Identification	2100 Hz	4.3.3.2
CFR	Confirmation to Receive	X010 0001 1850 or 1650 Hz for 3 sec.	5.3.6.1 D1) 4.3.1.2
CRP	Command Repeat	X101 1000	5.3.6.1 H2)
CIG	Calling Subscriber Identification	1000 0010	5.3.6.1 B2)
CNG	Calling Tone	1100 Hz for 500 ms	4.3.3.3
CSI	Called Subscriber Identification	0000 0010	5.3.6.1 A2)
DCN	Disconnect	X101 1111	5.3.6.1 H1)
DCS	Digital Command Signal	X100 0001	5.3.6.1 C1)
DIS	Digital Identification Signal	0000 0001	5.3.6.1 A1)
DTC	Digital Transmit Command	1000 0001	5.3.6.1 B1)
EOM	End of Message	X111 0001 1100 Hz	5.3.6.1 F1) 4.3.2.4
EOP	End of Procedure	X111 0100	5.3.6.1 F3)
FCF	Facsimile Control Field	-	5.3.6.1
FIF	Facsimile Information Field	-	5.3.6.2
FTT	Failure To Train	X010 0010	5.3.6.1 D2)
GC	Group Command	1300 Hz for 1.5 - 10.0 sec. 2100 Hz for 1.5 - 10.0 sec.	4.3.2.1
GI	Group Identification	1650 and/or 1850 Hz	4.3.1.1
HDLC	High-Level Data Link Control	-	5.3
LCS	Line Conditioning Signals	1100 Hz	4.3.2.2
MCF	Message Confirmation	X011 0001 1650 or 1850 Hz	5.3.6.1 G1) 4.3.1.3
MPS	Multi-Page Signal	X111 0010	5.3.6.1 F2)
NSC	Non-Standard Facilities Command	1000 0100	5.3.6.1 B3)
NSF	Non-Standard Facilities	0000 0100	5.3.6.1 A3)
NSS	Non-Standard Set-Up	X100 0100	5.3.6.1 C3)
PIN	Procedural Interrupt Negative	X011 0100	5.3.6.1 G5)
PIP	Procedural Interrupt Positive	X011 0101	5.3.6.1 G4)
PIS	Procedure Interrupt Signal	462 Hz for 3 sec.	4.3.3.1
PRI-EOM	Procedure Interrupt-EOM	X111 1001	5.3.6.1 F4)
PRI-EOP	Procedure Interrupt-EOP	X111 1100	5.3.6.1 F6)
PRI-MPS	Procedure Interrupt-MPS	X111 1010	5.3.6.1 F5)
RTN	Retrain Negative	X011 0010	5.3.6.1 G3)
RTP	Retrain Positive	X011 0011	5.3.6.1 G2)
TCF	Training Check	0's for 1.5 sec.	5.3.6.1 C4)
TSI	Transmitting Subscriber Identification	X100 0010	5.3.6.1 C2)

Table 3-5

BIT NO.	DIS/DTC	DCS
1	Transmitter - T.2 operation	
2	Receiver - T.2 operation	Receive - T.2 operation
3	T.2, IOC = 176	
4	Transmitter - T.3 operation	
5	Receiver - T.3 operation	Receive - T.3 operation
6	Reserved for future T.3 operation features	
7	Reserved for future T.3 operation features	
8	Reserved for future T.3 operation features	
9	Transmitter - RS 465 operation	
10	Receiver - RS 465 operation	Receive - RS 465 operation
11,12	Data signalling rate	Data signalling rate
(0,0)	V.27 ter fallback mode	2400 bits per second V.27 ter
(0,1)	V.27 ter	4800 bits per second V.27 ter
(1,0)	V.29	9600 bits per second V.29
(1,1)	V.27 ter and V.29	7200 bits per second V.29
13	Reserved for new modulation system	
14	Reserved for new modulation system	
15	Vertical resolution = 7.7 line/mm	Vertical resolution = 7.7 line/mm
16	Two-dimensional coding capability	Two-dimensional coding
17	Maximum width of paper 256mm (B4)	Maximum width of paper 256mm (B4)
18	Maximum width of paper 297mm (A3)	Maximum width of paper 297mm (A3)
19	Maximum length of paper 364mm (B4)	Maximum length of paper 364mm (B4)
20	Unlimited length of paper	Unlimited length of paper
21,22,23	Minimum scan line time at the receiver	Minimum scan line time at the receiver
(0,0,0)	20 msec. @ 3.85 l/mm; $T_{7.7} = T_{3.85}$	20msec.
(0,0,1)	40 msec. @ 3.85 l/mm; $T_{7.7} = T_{3.85}$	40msec.
(0,1,0)	10 msec. @ 3.85 l/mm; $T_{7.7} = T_{3.85}$	10 msec.
(1,0,0)	5 msec. @ 3.85 l/mm; $T_{7.7} = T_{3.85}$	5 msec.
(0,1,1)	10 msec. @ 3.85 l/mm; $T_{7.7} = 1/2\ T_{3.85}$	
(1,1,0)	20 msec. @ 3.85 l/mm; $T_{7.7} = \frac{1}{2} T_{3.85}$	
(1,0,1)	40 msec. @ 3.85 l/mm; $T_{7.7} = \frac{1}{2} T_{3.85}$	
(1,1,1)	0 msec. @ 3.85 l/mm; $T_{7.7} = T_{3.85}$	0 msec.
24	Extend field	Extend field
25	2400 bits per second handshaking	2400 bits per second handshaking
26	Uncompressed mode	Uncompressed mode
27	Unassigned	
28	Unassigned	
29	Unassigned	
30	Unassigned	
31	Unassigned	
32	Extend field	Extend field

Note 1. Standard facsimile units conforming to CCITT Recommendation T.2 must have the following capability: IOC = 264

Note 2. Standard facsimile units conforming to CCITT Recommendation T.3 must have the following capability: IOC = 264

Note 3. Standard facsimile units conforming to EIA standard RS 465 must have the following capability: Paper length = 297 mm

Note 4. Where the DIS or DTC frame defines RS-465 standard modem capabilities, the equipment may be assumed to be operable at either 4800 or 2400 bits per second.

Where the DIS or DTC frame defines RS-465 optional modem capabilities, the equipment may be assumed to be operable at either 9600 or 7200 bits per second.

Note 5. $T_{7.7}$ and $T_{3.85}$ refer to the scan line times to be utilized when the vertical resolution is 7.7 lines/mm or 3.85 lines/mm, respectively (see bit 15 above). $T_{7.7} = \frac{1}{2} T_{3.85}$ indicates that in the high resolution mode, the scan line time can be decreased by half.

Note 6. The standard FIF field for the DIS, DTC, and DCS signals is 24 bits long. If the "Extend Field" bit(s) is a "1", the FIF field shall be extended by an additional eight bits.

Delays, time-outs, timing tolerances will be monitored during testing and reported by exception.

Reduced, or otherwise specialized, test sequences will be used for diagnostic purposes in the event the facsimile unit under test fails to exhibit performance in accordance with the standards.

3.3 TEST PLAN

Tables 3-6 and 3-7 present Delta Information Systems' Standards Conformity Test Plan and Timing Tolerance Monitoring procedure. The Test Plan consists of ten individual tests which collectively provide an ample framework for validating even Group 3 machines loaded with a full range of options. As can be seen the test parameters, in Table 3-6, are divided into four major groups:

1. Those which establish the broad operating conditions for the test (line items 1 through 5);
2. Those which permit exercise of equipment options (line items 6 through 11)
3. Those which establish conditions for error responses (line items 12 through 25).
4. Those which verify operation of the UUT when interfacing with a Group 3 device having signals operating at the extremities of their specified signal duration.

The first group is self explanatory.

The second group is sensitive to what particular options are implemented in the Unit Under Test (UUT). Therefore, before running any given test it may be necessary to alter values of line items 6 through 11 to make the test feasible and meaningful. However, if the test will produce evidence of compliance with mandatory fallback requirements the line items involved will not be changed.

The third group of test parameters in table 3-6 show

Table 3-6
TEST PLAN

TEST PARAMETER \ TEST NO.		1	2	3	4	5	6	7	8	9	10
	Oc.Method	1T	2T	3T	4R	4R	4T	4T	4R/4T	NA	NA
	Tester	MNL	MNL	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
1. Operating Method	UUT**	MNL	AUTO	MNL	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
2. Calling Station		UUT	TESTER	TESTER	TESTER	UUT	TESTER	UUT	TESTER	UUT	UUT
3. Document Exchange		NO	NO	NO	NO	NO	NO	NO	YES	NO	NO
4. Pages/document		1	1	1	1	2	2	2	2 each way	NONE	NONE
5. Document originator		UUT	TESTER	TESTER	UUT	TESTER	TESTER	UUT	BOTH	NO	NO
FIRST FIF FIELD OF CALLED PARTY (OPTIONAL EQUIPMENT PARAMETERS)											
6. Compression Code (Huff/Read)		H	R	H	R	R	H	H	H	H	H
7. Minimum Scan Line Time (ms)		20	10/20*	20/40*	0/20*	5/20*	10/20*	10/20*	20	20	20
8. Vert.Resolution (l/mm)		3.85	7.7	3.85	7.7	7.7	7.7	7.7/3.85*	3.85	3.85	3.85
9. Max.Paper Width (mm)		216	256	297	216	256	297	216	216	216	216
10. Max. Paper Length (mm)		297	364	297	364	297	297	297	297	297	[illegible]
11. Data Signalling Rate (bps)		2400	4800	7200	9600	9600	7200	4800	2400	2400	[illegible]
ERROR EVALUATION											
12. Tester ignores recpt of valid DIS once		NO	NO	NO	YES	NO	YES	NO	NO	NO	NO
13. Tester ignores recpt of valid EOM once		NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
14. Generate false MPS/PPS		NO	NO	NO	NO	NO	YES	NO	NO	NO	NO
15. Ignore EOP/Send CRP		NO	NO	NO	YES	NO	NO	NO	NO	NO	NO
16. Generate false EOP, Manually send CRP		NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
17. Following training send FTT		NO	NO	NO	YES	NO	NO	YES	NO	NO	NO
18. DIS is not sent; measure T1		NO	NO	NO	NO	NO	NO	NO	NO	YES	NO
19. EOM is not sent; measure T2		NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
20. UUT initiates PIP: no operator intervention; measure T3		NO	NO	NO	NO	YES	NO	NO	NO	NO	NO
[illegible] EOM: send RTP		NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
[illegible] Transmission of Optional Frame (e.g.CSI,CIG)		YES	YES	YES	YES	YES	YES	YES	YES	NO	[illegible]
[illegible] Tester will send a non-group [illegible] response to [illegible]											
[illegible] of the UUT [illegible]		NO	NO	NO	NO	NO	NO	NO	NO	NO	
[illegible]		NO	NO	NO	YES	YES	NO	NO	NO	NO	NO
[illegible]		YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
TIMING											
[illegible] ration of Preamble of flags from tester (sec)		.86	.86	.86	.86	.86	1.14	1.14	1.14	1.14	[illegible]

* Second figure refers to responding FIF field
** Unit Under Test

TABLE 3-7

TIMING TOLERANCE MONITORING

	TIMING TOLERANCE
Training Check	1.5 sec ± 10%
Delay between ID Transmissions-Man.	4.5 sec ± 15%
Delay between ID Transmissions-Auto.	3.0 sec ± 15%
T1 (Attempt ID) Time Out	35.0 sec ± 5 sec
T2 (CMD/Resp) Time Out	6.0 sec ± 1 sec
T3 (Oper. Interr.) Time Out	10.0 sec ± 5 sec
Delay after EOM or RTC	75.0 MS ± 20 MS
Frame Duration	3.0 sec ± 15%
HDLC Preamble Duration	1.0 sec ± 15%

the methodology for simulating errors. Table 3-8 shows the actual error conditions simulated in each case. Table 3-8 also summarizes the conditions of test and the operating method under which each of the error conditions are simulated.

Tests 1 and 8 have Facsimile Information Field (FIF) bits set to achieve a standard equipment set-up. These tests validate basic capabilities by simple manual exercise and extensive automatic exercise of the UUT, respectively.

Test 9 is designed to validate the UUT with respect to T3, operator intervention time-out.

Test 10 is designed to determine the UUT response relative to a non-group 3 command.

Tests 3 through 7 exercise the UUT under a wide range of equipment options and simulated error conditions. Test 3 uses operating method 3 - automatic operation of called station; tests 4 through 7 use operating method 4 - automatic operation of both calling and called stations. Test 2 exercises the UUT, under certain equipment options using operating method 2, manual operation of calling station and automatic operation of called station. In tests 4 and 5 the switched telephone simulator will degrade the received signal to cause a fall back in the data rate.

Within the general framework of the test plan, signal sequences will be chosen so the ten tests collectively accomplish full exercise of standard features and mandatory responses.

It is expected that timing, Table 3-7, will be monitored

		CONDITIONS OF TEST				ERROR EVALUATION		
TEST NO.	TABLE 3-6 LINE NO.	CALLING STATION	FIRST FIF	DOCUMENT ORIGIN	OPERATING METHOD: OVERALL DESIGNATION	ERROR CONDITION SIMULATED	ERROR REACTION DELAY	REQUIRED UUT REACTION TO ERROR CONDITION
4/6	12	Tester / Tester	UUT	UUT / Tester	4R / 4T	DIS Handshake failure	3sec±15%	DIS Repeated
7	13	UUT	Tester	UUT	4T	CMD Handshake Resp. failure	3sec±15%	EOM Repeated
6	14	Tester	UUT	Tester	4T	FCS Error	3sec±15%	False MPS Discarded
4		Tester	UUT	UUT	4R	CMD Failure/ CRP Option Invoked	N.A.	Respond to CRP*: EOP repeated
3	16	Tester	UUT	Tester	3T	FCS Error	N.A.	False EOP discarded Send CRP*
4/7	17	Tester / UUT	UUT / Tester	UUT	4R / 4T	Failure to train	N.A.	Respond to FII: Retrain TCF
9	18	UUT	Tester	N.A.	N.A.	Identification failure Time Out	T1= 35±5Sec	DIS repeated till T1 expired Disconnect
7	19	UUT	Tester	UUT	4T	CMD Resp.Time Out	T2= 6±1Sec	Repeat EOM. After 3rd try Disconnect
5	20	UUT	Tester	Tester	4R	OPER.INTERR. Time Out	T3= 10±5Sec.	After T3,discontinue Oper.Interr.attempt and send other CMD/Resp
7	21	UUT	Tester	UUT	4T	CMD Retrain Msg OK	N.A.	Respond to RTP: Retrain TCF
1-8	22	Varies from Test to Test				Unimplemented Option	N.A.	Disconnect after 3 unsuccessful attempts
10	23	UUT	Tester	N.A	N.A.	Inappropriate Response	N.A.	Disconnect after 3 unsuccessful attempts
4/5	24	Tester / UUT	UUT / Tester	UUT / Tester	4R	Excessive Trans-mission error rate	N.A.	Fallback to lower transmission bit rate
1-8	25	Varies from Test to Test				Bit #24 in the FIF field is exercised	N.A.	UUT should ignore

* optional

TEST PLAN METHODOLOGY FOR ERROR EVALUATION

TABLE 3-8

continuously. However, monitored results will be reported only in the event tolerance or time out limits are violated.

As an illustrative example consider Test 5 of table 3-6:

-BROAD OPERATING CONDITIONS

Both stations are automatic, the UUT calls and receives a two page document from the Tester so the overall designation of the operating method for Test 5 is 4R.

-EQUIPMENT OPTIONS

The first FIF field associated with the called party (tester) DIS has the appropriate bits (see table 3-5) set to request the UUT to set-up for:

Two dimensional (READ) compression code

Minimum Scan Line Time 5 seconds

Vertical Resolution 7.7 lines/mm

Max. Paper Width 256 mm

Max. Paper Length 297 mm

Data Signalling Rate 9600 bps

This is intended to exercise the UUT relative to mandatory fall back. The responding FIF field associated with the calling party (UUT) DTC has all bits corresponding to the first FIF field except the minimum scan line time bit is set to request that the Tester set-up to 20 seconds for this parameter. The Tester responds with an FIF field, associated with the DCS command, in which all bits agree with the preceding FIF field confirming that the two

stations are now compatible. The signal sequence continues to accomplish document transmittal.

-ERROR EVALUATION

In Test 5 a procedural interrupt, PIN, is sent by the UUT and ignored by the tester so that T3, Operator Interrupt Time Out, may be validated.

UNIMPLEMENTED OPTIONS ON UUT

In the event Test 5 involved equipment options which have no provision for fallback the first FIF field associated with the called party (Tester) DIS will have the bits for the unimplemented options altered prior to running the test, to make the test feasible.

For the validation procedure to be meaningful it is necessary that the tester be calibrated periodically to verify that its parameters precisely correspond to Group 3 standards.

The test plan utilizing the proposed validation facility, along with test documents designed to fully exercise both one and two dimensional coding algorithms, constitute the principal embodiment of Delta Information Systems' validation test methodology.

4.0 VALIDATION SYSTEM IMPLEMENTATION

4.1 Hardware

A functional block diagram of the validation system is shown in Figure 4-1. The system is composed of three parts - a General Purpose System Control Subsystem (GPSCS), a Facsimile Communication Subsystem (FCS), and a telephone network simulator.

The GPSCS is an intelligent terminal including CRT, keyboard, dual floppy discs, and 56K bytes of memory. Two spare connector slots are provided to gain access to the processor bus. One of these will be used for the data interface to the FCS. This interface is basically a DMA channel (8 bit parallel) with DMA controllers in both the FCS and the GPSCS. This channel will be used to transmit test data in compressed form from the memory of the GPSCS to the facsimile unit under test. Likewise, the channel will be used for data flowing in the opposite direction; compressed data from the facsimile unit under test will be captured in the random access memory of the GPSCS via the DMA channel. This test data will be transferred to disk for subsequent analysis. In addition to the data channel between the GPSCS and the FCS, a serial asynchronous channel is provided for the flow of control/status information.

The FCS is made up of line control units, modems, and modem control and switching circuits, all under the

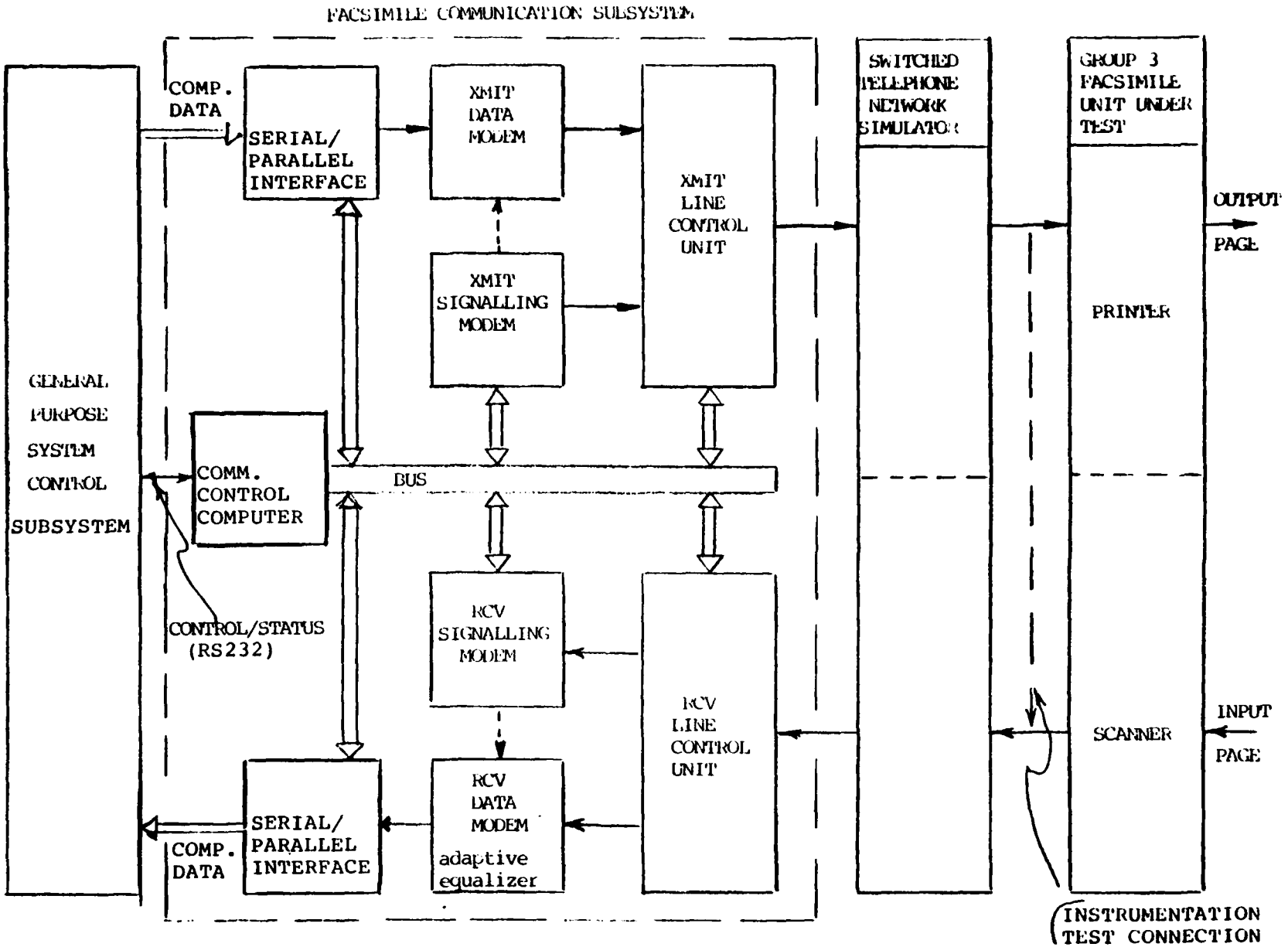


FIGURE 4-1 FUNCTIONAL BLOCK DIAGRAM OF VALIDATION SYSTEM

control of a microcomputer. The line control units provide the interface between the validation system and the facsimile unit under test. The V.27 ter/V.29 modems handle the facsimile data at the various data rates required by Group 3. The serial-to-parallel interface transfers serial data from the modems to 8 bit parallel for use by the GPSCS and vice-versa by means of DMA. That is, the data is transformed from serial to parallel via a microcomputer peripheral chip and latched into a register using a DMA controller. This data can be retrieved subsequently by the GPSCS, also by a DMA operation. This operation is bidirectional. The communications control computer, which controls all elements of the FCS, has a standard microcomputer architecture consisting of microprocessor, RAM, ROM, timer and asynchronous communications interface adapter (ACIA). The ACIA is used to communicate commands/ status to and from the GPSCS.

The network simulator will be simply an attenuator to simulate circuits with high loss.

4.1.1 Mechanical

The Group 3 Validation System equipment consists of two physically distinct parts. These are, the General Purpose System Control Computer and the Facsimile Communication Subsystem:

GPSCC

The GPSCC unit will perform the function of General Purpose System Control Computer.

It is a one-piece desk-top unit with full ASCII keyboard and 9" CRT display. Mechanical specifications are as follows:

Dimension:

19 x 11 x 26 inches (w,h,d)

Weight:

49 lbs (22.2 kg)

Power:

100-130/200-250V (jumper selectable), 45-100Hz,100W

Interface Connections:

1. Asynchronous, serial, control interface (RS-232C) with FCS
2. Parallel, DMA interface with FCS

FACSIMILE COMMUNICATION SUBSYSTEM (FCS)

The FCS will be housed in a 19" open relay rack. All manual controls and indicators will be located on the front panel. Interface connectors will be mounted on the rear of the unit. Approximate mechanical specifications are as follows:

Dimensions:

22 x 36 x 18 inches (w,h,d)

Power:

115 VAC

Interface Connections:

1. Asynchronous, serial control interface (RS-232C) with GPSCS.

2. Parallel, DMA interface with GPSCS.
3. Interface to facsimile unit under test.

4.2 Software

Software/firmware must be provided for both the FCS and GPSCS. The primary function of the FCS software is to provide link establishment, message transfer, and link termination for the Group 3 facsimile unit under test. This includes verification of the proper remote device type and emulation of the analog or digital line protocol of that device. This is achieved by means of control software for the line control units, modems and serial-to-parallel interface.

A significant portion of the FCS software is devoted to communication with the GPSCS. Commands from the GPSCS must interpreted and responses must be provided. This is accomplished by means of a high/level command/response protocol. A system of this complexity, employing concurrent processes, also must have an operating system to perform the required supervisory, scheduling, prioritizing and routine functions.

The purpose of the GPSCS software is to control the validation test, analyze the test data and other test results, and to generate validation reports. The GPSCS communicates with an operator via CRT and keyboard, formulates commands to the FCS, and communicates with

the FCS via the high level command/response protocol.

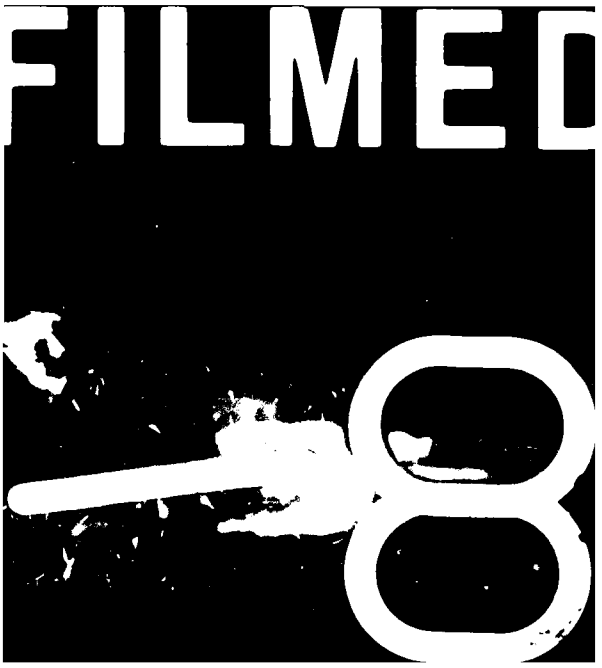
The GPSCS software must provide the test data, in compressed form to be transmitted to the facsimile unit under test. Conversely it must receive the compressed data from the unit under test, store it in real time, analyze it and report the results. Results may be displayed on the CRT in graphic form and/or as text.

4.2.1 Test Pages

Test pages are used to exercise the facsimile unit under test, operating both as a scanner and as a printer. In order to transmit a test page to the unit under test, the test page will be stored initially on floppy disk in compressed data form, either Huffman or Modified Read. Each test page will be designed to minimize the volume of compressed data so that the page may be stored in RAM for real-time transmission. Nevertheless, the test page will be adequate to test all aspects of the desired code. The Huffman decoding capabilities will be tested by transmitting a 45 degree edge long enough to use all of the terminating codes, followed by a staircase for the make up codes. The Modified Read decoder will be sent a set of black-white edges of various slopes plus isolated rectangles to exercise the verticle, horizontal and pass modes in various combinations.

Similar test pages will be used to test the facsimile scanner. Test pages will be fed through the scanner, transmitted, received and analyzed by the GPSCS. This aspect of the testing is somewhat more difficult than that described in the previous paragraph, due to the possible mis-registration of the test page in the scanner. To aid the registration, each test page will have registration marks in at least three corners. Horizontal and vertical offsets and skewing can be compensated for in the GPSCS software. In order to do this it will be necessary to decode the compressed data, although it does not have to be decoded in real time.

Rather than employ separate scan and print operations it may be desirable to combine the two in one test having two parts. In the first part a test document is scanned and stored in the GPSCS. In the second part the stored document would then be fed to the printer. In this way the software registration requirements are alleviated.


FILMED